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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.

VS

EXAMINER

ART UNIT	PAPER NUMBER
	12

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

1/27/00 (3 mo.)

Last response 3/27/00 (pays 3 mo ext.)

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Office Action Summary	Application No. 09/123,352	Applicant(s) Yunlong et al
	Examiner Rudy Zervigon	Group Art Unit 1763

X Responsive to communication(s) filed on 9/29/99.

This action is **FINAL**.

Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

X Claim(s) *1-16* is/are pending in the application.

Of the above, claim(s) ______ is/are withdrawn from consideration.

Claim(s) ______ is/are allowed.

X Claim(s) *1-16* is/are rejected.

Claim(s) ______ is/are objected to.

Claims ______ are subject to restriction or election requirement.

Application Papers

See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

The drawing(s) filed on ______ is/are objected to by the Examiner.

The proposed drawing correction, filed on ______ is approved disapproved.

The specification is objected to by the Examiner.

The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

X Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

X All Some* None of the CERTIFIED copies of the priority documents have been

X received.

received in Application No. (Series Code/Serial Number) ______.

received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: ______

Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

X Notice of References Cited, PTO-892

X Information Disclosure Statement(s), PTO-1449, Paper No(s). *8*

Interview Summary, PTO-413

Notice of Draftsperson's Patent Drawing Review, PTO-948

Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed September 29, 1999 have been fully considered but they are not persuasive. Arguments traversing rejections made to claims 1-12, 14, and 15 in the first Office Action (paper number 7, March 29, 1999) strictly center on the alleged deficiency of the cited references to exhibit the claim 1 limitation: "said magnetic force lines that pass through a center of said plasma generation region are shaped so that they do not intersect said two walls". The base reference in all the rejections to claims 1-12, 14, and 15 is Kisakibaru et al (United States Patent 5,431,769).

2. Applicant's arguments with respect to claims 1-12, 14, and 15 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-11,13,16 are rejected under 35 U.S.C. 102(b) as being anticipated by David W. Benzing (U.S. Patent 4,572,759). David W. Benzing describes an apparatus for plasma assisted operations utilizing "three electrodes together with an optional magnetic enhancement." (column 1, lines 5-14). Specifically, David W. Benzing describes a plasma generation chamber with the following attributes:

i. A plasma generation apparatus vacuum vessel (Figures 1,2; item 10; column 3, lines 42-64) having a plasma generation region formed from gas induction means for inducting discharge gas established in the interior thereof (column 4, lines 54-68)

ii. Exhaust means for exhausting the atmosphere "in the in the" interior of the vacuum vessel (column 3, lines 60-64)

iii. A cylindrical discharge electrode (item 14, all Figures; column 3, line 45; column 4, lines 32-34) fashioned to enclose the plasma volume

iv. A first high frequency electric power application means for applying high-frequency electric power to the cylindrical discharge electrode (item 14, all Figures; column 3, line 45; column 4, lines 32-34) fashioned to enclose the plasma volume (column 5, lines 3-*28*)

v. Magnetic force line formation means (items 102, Figure 4; column 6, lines 53-69) for forming magnetic force lines having portions roughly parallel to the center axis of the cylindrical discharge electrode (item 14, all Figures; column 3, line 45; column 4, lines 32-34) fashioned to enclose the plasma volume such that the length of the parallel portions become longer (less curved) the closer the magnetic force lines are to the central axis of the cylindrical discharge electrode (item 14, all Figures; column 3, line 45; column 4, lines 32-34) fashioned to enclose the plasma volume (Figure 12)

vi. Electrically conducting two walls (items 14,16, Figure 2) positioned so as to "sandwich" the plasma generation region between them in the dimension of the center axis of the cylindrical discharge electrode (item 14, all Figures; column 3, line 45; column 4, lines 32-34) fashioned to enclose the plasma volume for defining the scope of the plasma generation region in the center axial dimension

vii. The magnetic force lines fashioned to enclose the plasma volume such that the length of the parallel portions become longer (less curved) the closer the magnetic force lines are to the central axis of the cylindrical discharge electrode (item 14, all Figures; column 3, line 45; column 4, lines 32-34) fashioned to enclose the plasma volume (Figure 12) passing through a center of the plasma generation region so shaped as *not to intersect the electrically conducting two walls (items 14,16, Figure 2) positioned so as to "sandwich" the plasma generation region between them in the dimension of the center axis of the cylindrical discharge electrode (item 14, all Figures; column 3, line 45; column 4, lines 32-34)*

fashioned to enclose the plasma volume for defining the scope of the plasma generation region in the center axial dimension

viii. Power application and distribution between the triode configuration, including resonant matching, are anticipated by David W. Benzing (column 5, lines 1-27)

Claim Rejections - 35 USC § 103

5. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over David W. Benzing (U.S. Patent 4,572,759) as applied to claims 1-11 above, and further in view of Kinoshita et al. Kinoshita et al describe a chemical vapor deposition apparatus utilizing a magnetron discharge contained within a plurality of electrodes (column 1, lines 9-15). Specifically, from DETD(4), Kinoshita et al make reference to the first embodiment of the invention as shown in Figure 3. Figure 3 shows a plasma apparatus comprising *first electrode wall 1 (21)* and *second electrode wall 2 (22)* arranged parallel to each other in chamber 1. *First electrode wall 1 (21)* is *connected to a reference potential point* shown as one terminal of an AC, high frequency or RF power source 6 through blocking capacitor 7 and *second electrode wall 2 (22) connected to the same reference potential point* terminal of high frequency power source 6 through blocking capacitor 7. A wire connecting *first electrode wall 1 (21)* with one terminal of high frequency power source 6 through blocking capacitor 7 and a wire connecting *second electrode wall 2 (22)* with the other terminal of high

frequency power source 6 through the blocking capacitor 7 are insulated from chamber 1 by insulator 9, 9, respectively. A pair of three-piece sets of solenoids 12 are arranged outside chamber 1 surrounding the first and the second electrodes 21, 22 in an orientation such that magnetic field lines 11 are parallel to first and second electrodes 21, 22. Additionally, Kinoshita et al teach intricate *control means for controlling the magnitude of high frequency electric power* of a multitude of dependent and independent plasma electrodes as discussed above. In another embodiment detailed by Kinoshita et al (DETD(25), Figure 6) electric power Ph1 and Ph2 of *high frequency power sources* 16, 26 are supplied to *first and second wall electrodes* 21, 22 at an arbitrary phase difference and an *arbitrary power supply ratio* through blocking capacitor 7. Motivation for this design is so that a part of the light electrons in the plasma run into *first wall electrode (21)* and into *second wall electrode (22)*, which is stored in blocking capacitors 7 so that a negative self-bias voltage is generated. Ion sheaths in which positive ion densities are higher are generated in the neighborhood of *first wall electrode (21)* and *second wall electrode (22)* with the generation of the negative self-bias voltage. In the ion sheath section, there are positive ions having high densities. The ion sheath section increases so that strong electric fields are applied in a direction perpendicular to the *first and second wall electrodes* 21, 22. A person of ordinary skill in the art at the time the invention was made would consider Kinoshita et al's reference potential points to be an obvious extension of the David W. Benzing (U.S. Patent 4,572,759) apparatus as applied to claims 1-11 above. Motivation for combining the above references is again centered on providing plasma density and geometry

control which are conducive to isotropic etching. The references sited in this claim rejection provide additional motivation for each respective design criteria.

7. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over David W. Benzing (U.S. Patent 4,572,759) as applied to claims 1-11 above, and further in view of Smesny et al and Saito et al. Smesny et al describes an integrated circuit dry etch chamber (item 90, Figure 5; column 12, lines 11-28). Specifically, Smesny et al describe a *position adjustment means for adjusting positions of* a movable first *electrically conductive* wall **electrode** (item 92, Figure 5; column 12, line 15). In addition, DETD(22), Figure 5 shows an integrated circuit dry etching chamber 90. A chamber 90 preferably includes a movable upper *first electrically conductive wall* ***electrode*** 92 and a stationary *second wall* ***electrode*** *94*. Upper *first electrically conductive wall* ***electrode*** *92* is connected to a power supply, preferably at ground potential, whereas *second wall* ***electrode*** *94* is preferably coupled to an RF supply. A reactive gas etch material is inserted through a port (not shown) between upper and lower electrodes 92 and 94, respectively. In addition, DETD(23), the position and movement of upper *first electrically conductive wall* ***electrode*** *92* is controlled and monitored in part by one or more motors 96 and linear encoders 98. Also, DETD(24). Linear encoders 98 determine the relative position of upper *first electrically conductive wall* ***electrode*** *92* based upon a known position of lower electrode 96. Thus, relative position of the electrodes can be obtained using such an encoder technique. The relative positions of upper *first electrically conductive wall* ***electrode*** *92* with respect to *second wall* ***electrode*** *94* must be periodically calibrated in order to ensure proper gap distance between the electrodes. Unfortunately, calibration

between electrodes does not ensure calibration between wafer 10 upper surface and upper *first electrically conductive wall* ***electrode*** *92*, as is necessary for measuring and achieving more precise etching conditions. As upper *first electrically conductive wall* ***electrode*** *92* is moved up or down by rotating nut 100 and cam screw 102. Accurate distances between upper *first electrically conductive wall* ***electrode*** *92* and wafer 10 upper surface are optimally achieved using opto-electric, acoustic, etc., non-contact displacement sensors placed upon the upper surface. . . light emitting diode (LED) 104, and associated lens, provides suitable light energy directed upon the lower surface of upper *first electrically conductive wall* ***electrode*** *92*. Light energy reflects from the lower surface of upper *first electrically conductive wall* ***electrode*** *92* and back upon the upper surface of wafer 10. If upper *first electrically conductive wall* ***electrode*** *92* is at a proper distance, calibrated distance, from wafer 10, then a specified amount of reflected light will strike a photodiode sensor 106 formed upon wafer 10 and spaced from LED 104. In addition, DETD(25), wafer 10 can determine whether or not *first electrically conductive wall* ***electrode*** *92* is in its calibrated position based upon whether or not photodiode 106 receives a specified amount of reflected light. If upper electrode is in its calibrated position, then subsequently introduced standard wafers and *first electrically conductive wall* ***electrode*** *92* can be moved about its calibrated position leaving the operator fully aware of *first electrically conductive wall* ***electrode*** *92* position with respect to the ensuing wafer topography. Accordingly, wafer 10 and associated sensors 104 and 106 provide proper calibration. . .electrodes, and also provide information to the operator about the relative distance between wafer 10 upper surface and upper electrode 92 lower surface if *first electrically conductive wall* ***electrode*** *92* should

ever change position through the activation of motors 96 and encoder 98. Smesny et al however does not specifically describe a movable *second wall* **electrode.** Saito et al, as described above, additionally describes *position adjustment means for adjusting positions of* a movable *second wall* **electrode** *in the dimension of the center axis of* Saito et al's plasma reactor. A person of ordinary skill in the art at the time the invention was made would consider the enhancements by Smesny et al and Saito et al to the David W. Benzing apparatus, as applied to claims 1-11 above, to be obvious at the time the invention was made. Motivation for combining the above references centers on the common objective to control plasma density and geometry attributes. The positioning of the upper and lower wall electrodes further confines and alters the plasma surface contour which is consistent with plasma density control and manipulation in order to control plasma processing near the substrate surfaces.

8. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over David W. Benzing (U.S. Patent 4,572,759) as applied to claims 1-11 above, and further in view of Inazawa et al. The references used in this rejection, other than Inazawa et al, do not describe the specifics of claim 15. Inazawa et al describe a plasma processing apparatus that is designed to increase the etching selection ratio. In addition, BSUM(16),Inazawa et al provides a plasma etching method in which a processing gas is introduced into a processing room housing a substrate, an RF power is applied across opposite electrodes to cause the processing gas to discharge, thereby generating a plasma, and a first layer supported by the substrate is etched by using the plasma in preference to a second layer supported by the substrate and consisting of a material different from that of the. Specifically,

DETD(9), the ceiling portion of the processing chamber 16 is defined by an *upper first electrically conductive wall electrode* 40. a portion between the side wall and ceiling portion of the processing chamber 16 are sealed by a seal member 41 constituted by, e.g., an O-ring. The *upper first electrically conductive wall electrode* 40, the side wall of the processing chamber 16, and the exhaust ring 25 are grounded. Therefore, when an RF power. . . an RF electric field in the processing room 14a, the *second wall electrode 24* functions as a cathode electrode, and the members 40, 16, and 25 function as an anode electrode. In addition, the *second wall electrode 24 is used as a holder for holding objects (Item W, Figure 1) to be treated (see Figure 1).* In addition, DETD(10), the *upper first electrically conductive wall electrode* 40 consists of a conductive material such as amorphous carbon, SiC, or Al. The *upper first electrically conductive wall electrode* 40 has a shower head structure *gas diffusion plate*. More specifically, the *upper first electrically conductive wall electrode* 40 has a hollow interior, and a large number of *gas diffusion holes* 42 are formed in its entire surface opposite to the wafer W. a dispensing plate (not shown) is disposed in the *upper first electrically conductive wall electrode* 40. An etching gas fed into the *upper first electrically conductive wall electrode* 40 through a gas feed pipe 44 is uniformly sprayed into the processing chamber 16 through the gas diffusion holes 42. a person of ordinary skill in the art at the time the invention was made would consider the teachings of Inazawa et al to be an obvious improvement over the David W. Benzing plasma reactor. Motivation for combining the above references is drawn from the added advantage of evenly distributing the process gas introduced into the process chamber over the entire length of the reactor volume as is commonly accomplished when using shower head gas distributors.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U.S. Patents 5,605,576; 5,589,737

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official AF fax phone number for the 1763 art unit is (703) 305-3599. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661.

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